Progress in the reprogramming of somatic cells.

Journal: Circ Res

Publication Year: 2013

Authors: Tianhua Ma, Min Xie, Timothy Laurent, Sheng Ding

PubMed link: 23371904

Funding Grants: Reprogramming of human somatic cells back to pluripotent embryonic stem cells

Public Summary:
Pluripotent stem cells can differentiate into nearly all types of cells in the body. This unique potential provides significant promise for cell-based therapies to restore tissues or organs destroyed by injuries, degenerative diseases, aging, or cancer. The discovery of induced pluripotent stem cell (iPSC) technology offers a possible strategy to generate patient-specific pluripotent stem cells. However, because of concerns about the specificity, efficiency, kinetics, and safety of iPSC reprogramming, improvements or fundamental changes in this process are required before their effective clinical use. A chemical approach is regarded as a promising strategy to improve and change the iPSC process. Dozens of small molecules have been identified that can functionally replace reprogramming factors and significantly improve iPSC reprogramming. In addition to the prospect of deriving patient-specific tissues and organs from iPSCs, another attractive strategy for regenerative medicine is transdifferentiation-the direct conversion of one somatic cell type to another. Recent studies revealed a new paradigm of transdifferentiation: using transcription factors used in iPSC generation to induce transdifferentiation or called iPSC transcription factor-based transdifferentiation. This type of transdifferentiation not only reveals and uses the developmentally plastic intermediates generated during iPSC reprogramming but also produces a wide range of cells, including expandable tissue-specific precursor cells. Here, we review recent progress of small molecule approaches in the generation of iPSCs. In addition, we summarize the new concept of iPSC transcription factor-based transdifferentiation and discuss its application in generating various lineage-specific cells, especially cardiovascular cells.

Scientific Abstract:
Pluripotent stem cells can differentiate into nearly all types of cells in the body. This unique potential provides significant promise for cell-based therapies to restore tissues or organs destroyed by injuries, degenerative diseases, aging, or cancer. The discovery of induced pluripotent stem cell (iPSC) technology offers a possible strategy to generate patient-specific pluripotent stem cells. However, because of concerns about the specificity, efficiency, kinetics, and safety of iPSC reprogramming, improvements or fundamental changes in this process are required before their effective clinical use. A chemical approach is regarded as a promising strategy to improve and change the iPSC process. Dozens of small molecules have been identified that can functionally replace reprogramming factors and significantly improve iPSC reprogramming. In addition to the prospect of deriving patient-specific tissues and organs from iPSCs, another attractive strategy for regenerative medicine is transdifferentiation-the direct conversion of one somatic cell type to another. Recent studies revealed a new paradigm of transdifferentiation: using transcription factors used in iPSC generation to induce transdifferentiation or called iPSC transcription factor-based transdifferentiation. This type of transdifferentiation not only reveals and uses the developmentally plastic intermediates generated during iPSC reprogramming but also produces a wide range of cells, including expandable tissue-specific precursor cells. Here, we review recent progress of small molecule approaches in the generation of iPSCs. In addition, we summarize the new concept of iPSC transcription factor-based transdifferentiation and discuss its application in generating various lineage-specific cells, especially cardiovascular cells.